IN THE SPECIFICATION

Before the paragraph beginning at prenumbered line 1, of page 1, please insert the following section headings:

BACKGROUND OF THE INVENTION

Field of the Invention

Before the paragraph beginning at line 4, of page 1, please insert the following section heading:

Discussion of the Background

Please replace the paragraph at page 2, lines 3-17, with the following rewritten paragraph:

More recently a method of multiuser detection with maximum likelihood using a representation by a lattice of points was proposed by L. Brunel et al., in an article entitled "Euclidian space lattice decoding for joint detection in CDMA system" published in Proceedings of ITW, page 129, June 1999. According to this method, a vector characteristic of the received signal representing a statistic sufficient for the maximum likelihood detection of the symbols transmitted by the different users is determined. It is shown under certain conditions that the characteristic vector can be represented as the point in a lattice disturbed by a noise. The detection then consists of seeking the point in the lattice closest to the point corresponding to the vector received. However, the dimension of the lattice to be used generally being [[$2.K$]] $\underline{2K}$ where K is the number of users, the number of points to be tested is high. To simplify detection, it has been proposed to limit the search for the closest neighbor to the points in the lattice belonging to a sphere centered around the point received.

This simplified detection method, referred to as the "method of detection by spheres", will be disclosed below:

Please replace the paragraph at page 4, lines 1-3, with the following rewritten paragraph:

It will be demonstrated below that $\mathbf{y}_2(i)$, as given by equation (6), can be represented as a point in a lattice Λ_2 of dimension [[*2.K*]] <u>*2K*</u>, with a generator matrix $\mathbf{M}_2$ corrupted by a noise $\mathbf{n}_2$.

Please replace the paragraph at page 5, lines 29-32, with the following rewritten paragraph:

By means of this transformation, which is assumed to be implicit hereinafter, the vector $\mathbf{d}_2(i)\mathbf{M}_2$ then belongs to a lattice of points Λ_2 of dimension [[*2.K*]] <u>*2K*</u> as defined by equation (7) with $\mathbf{G}=\mathbf{M}_2$. The vector $\mathbf{y}_2(i)$ can then be considered to be a point in the lattice Λ_2 corrupted by a noise $\mathbf{n}_2(i)$.

Please replace the paragraph beginning at page 6, line 27, through page 7, line 2, with the following rewritten paragraph:

Fig. 2 depicts schematically a multiuser detection device using a method of detection by spheres. The received signal *n* is filtered by a battery of filters adapted to each of the users, $210_1,\ldots,210_K$. The real and imaginary components of the observation vector $\mathbf{y}_2(i)$ output from the adapted filters are transmitted to a matrix calculation unit performing the spectral whitening operation according to equation (14). The real and imaginary components of the whitened vector $\tilde{\mathbf{y}}_2(i)$ are then transmitted to a unit for detection by spheres seeking the closest neighbor of the point received within the lattice Ω_2 of dimension [[*2.K*]] <u>*2K*</u>. The

coordinates of the closest neighbor directly give the real and imaginary components of the estimated symbols $\hat{d}_k(i)$ for the different users.

Before the paragraph beginning at line 8, on page 7, please insert the following section heading:

SUMMARY OF THE INVENTION

Please replace the paragraph at page 7, lines 26-28, with the following rewritten paragraph:

According to a variant embodiment, the search for the closest neighbor is limited to the points of the constellation belonging to a sphere centered on the ~~said~~ projected point.

Please replace the paragraph at page 7, lines 32-34, with the following rewritten paragraph:

The search for the closest neighbor is advantageously limited to the points in the affine subspace belonging to a sphere of the ~~said~~ subspace centered on the ~~said~~ projected point.

Please replace the paragraph at page 8, lines 1-3, with the following rewritten paragraph:

According to one advantageous embodiment, the projection step is performed only if the received point is distant from the ~~said~~ constellation by more than a predetermined distance.

Before the paragraph beginning at line 16, on page 8, please insert the following section heading:

BRIEF DESCRIPTION OF THE DRAWINGS

Please replace the subparagraph at page 8, lines 24-25, with the following rewritten paragraph:

Fig. 4 illustrates a preliminary operation of projection onto the constellation according to the invention; and

Before the paragraph beginning at line 8, on page 27, please insert the following section heading:

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Please replace the paragraph at page 9, lines 15-20, with the following rewritten paragraph:

It can easily be shown that the noise vectors $\mathbf{n}^R(i)$ and $\mathbf{n}^I(i)$ both have the covariance matrix ~~N_0.**R**(i) . **R** being~~ $N_0\,\mathbf{R}(i)$. Since **R** is a symmetrical matrix defined positive, it can be factorized according to a Cholesky decomposition: $\mathbf{R} = \mathbf{W}\mathbf{W}^T$ where **W** is an inferior triangular real matrix of size KxK. In order to decorrelate the noise components, the real observation vectors $\mathbf{y}^R(i)$ and $\mathbf{y}^I(i)$ are first of all subjected to a whitening operation:

Please replace the paragraph beginning at page 9, line 31, through page 10, line 6, with the following rewritten paragraph:

When the symbols of or for the users are transmitted asynchronously, the modeling of the system is more complex since it is necessary to take account of the fact that a symbol of a

user can interfere with two or even several consecutive symbols of another user. It can be shown in this case that it is possible to reduce the action to a search for the closest neighbor within a lattice of dimension [[$2.K'$]] $\underline{2K'}$ (K' in the case of real signatures) with $K'>K$ where K' is a function of the number of symbols not yet estimated which may interfere with each other. The detection is however not optimum in the sense of the maximum likelihood.

Please replace the paragraph at page 15, lines 1-28, with the following rewritten paragraph:

When the constellation has a parallelepipedal shape, for example when the modulation constellations of the different users are of the PAM or QAM type, the present invention proposes to orthogonally project the received point onto an affine subspace (or linear variety) delimiting or bordering the constellation. Fig. 4 depicts schematically a constellation in the form of a parallelogram (here k=2), to the right (401) in the canonical base of the Euclidian space $\mathbf{R}^k$ and to the left (402) in the base of the generator vectors of the lattice. It should be stated that a received point is represented by a vector **z** in the canonical base and by a vector ρ in the generator base, such that $\mathbf{z}=\tilde{\mathbf{n}}\mathbf{G}$. In the representation 401, the space $\mathbf{R}^k$ is provided with the Euclidian norm $\|z\|^2 = \sum_{i=1}^{k} z_i^2$ and at 402 with the norm $Q(\tilde{\mathbf{n}})=\tilde{\mathbf{n}}GG^T\tilde{\mathbf{n}}^T$. Thus a sphere centered on the received point **z** in the representation at 401 is transformed into an ellipsoid centered on the received point ρ at 402. As illustrated at 401, a received point not belonging to the constellation is first of all projected orthogonally onto the latter or more generally onto an envelope E of this constellation. The choice of the affine subspace onto which the projection is effected depends on the position of the received point. Thus, for example, the point M_1 belonging to the zone **I** delimited by the straight lines D_1, D_2, D_4 is projected onto the straight line D_1, the point M_2 belonging to the ~~sector~~ zone II

delimited by the straight lines D_1 and D_2 is "projected" onto the apex P_{12} (that is to say the image of any point belonging to this sector will be the point P_{12}), the point M_3 belonging to the zone III delimited by the straight lines D_2, D_1, D_3 is projected onto the straight line D_2, etc. As will be seen below, this choice of projection is sub-optimal. It is however preferred for its ease of implementation. Naturally, the different types of affine subspaces onto which a projection can be effected depend on the dimension of the lattice. Thus, for a ~~parallelepipedal~~ parallelepiped-shaped constellation generating a lattice of dimension 3, the affine subspaces to be considered will be the faces, the edges, and the vertices of the parallelepiped. In general terms, for a lattice of dimension k, the affine subspaces to be considered will be of dimension $N=k-L$ with $1\leq L\leq k$.